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Research, part of a Special Feature on New Methods for Adaptive Water Management

Assessing Management Regimes in Transboundary River Basins: Do They Support Adaptive Management?

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ABSTRACT. River basin management is faced with complex problems that are characterized by uncertainty and change. In transboundary river basins, historical, legal, and cultural differences add to the complexity. The literature on adaptive management gives several suggestions for handling this complexity. It recognizes the importance of management regimes as enabling or limiting adaptive management, but there is no comprehensive overview of regime features that support adaptive management. This paper presents such an overview, focused on transboundary river basin management. It inventories the features that have been claimed to be central to effective transboundary river basin management and refines them using adaptive management literature. It then collates these features into a framework describing actor networks, policy processes, information management, and legal and financial aspects. Subsequently, this framework is applied to the Orange and Rhine basins. The paper concludes that the framework provides a consistent and comprehensive perspective on transboundary river basin management regimes, and can be used for assessing their capacity to support adaptive management.

Key Words: *Adaptive management; management regime; Orange; Rhine; river basin; transboundary*

INTRODUCTION

In the past, river basin management was often the exclusive realm of hydraulic engineers, who managed the river for a single purpose only, such as navigation or hydropower. Nowadays, river basin management is often multi-purpose and basin-wide, and involves many more actors (cf. Ridder et al. 2005). Moreover, river basin management has to deal with increasing rates of human-induced change and increasing concerns about the causes and consequences of these changes (Toffler 1980, Pahl-Wostl 2004). In transboundary river basins, differences in legal frameworks, historical and cultural backgrounds, and technical capabilities add to the complexity (Timmerman and Langaas 2005).

Adaptive management has been proposed as a way of dealing with uncertainty and change (Holling 1978). It aims at developing robust and flexible management strategies that perform well under different possible futures and can be modified if necessary. It acknowledges that current knowledge will never be sufficient for future management (Pagan and Crase 2004). Therefore, policies are treated as hypotheses and their implementation as experiments to test them (Walters and Holling 1990, Gunderson 1999). Adaptive management requires a process of active learning by all stakeholders, and continuous improvement of management strategies by learning from the outcomes of implemented policies (Geldof 1995, Pahl-Wostl 2004, 2007). The learning process is not a matter of random trial and error, but a structured, cyclical process, involving 1) integrated assessment of current problems and possible solutions as perceived by different stakeholders, 2) setting goals, 3) formulation of policies that are hypothesized to contribute to reaching the goals, 4) implementation, to test the hypotheses, through 5) systematic monitoring and evaluation of policy outcomes, including surprises (Fig. 1). In practice, these are not distinct stages, as the system pulses through alternating spurts of learning and implementing.

By involving all relevant stakeholders in the assessment and goal-setting stages, an overview of relevant technical knowledge, values, and interests

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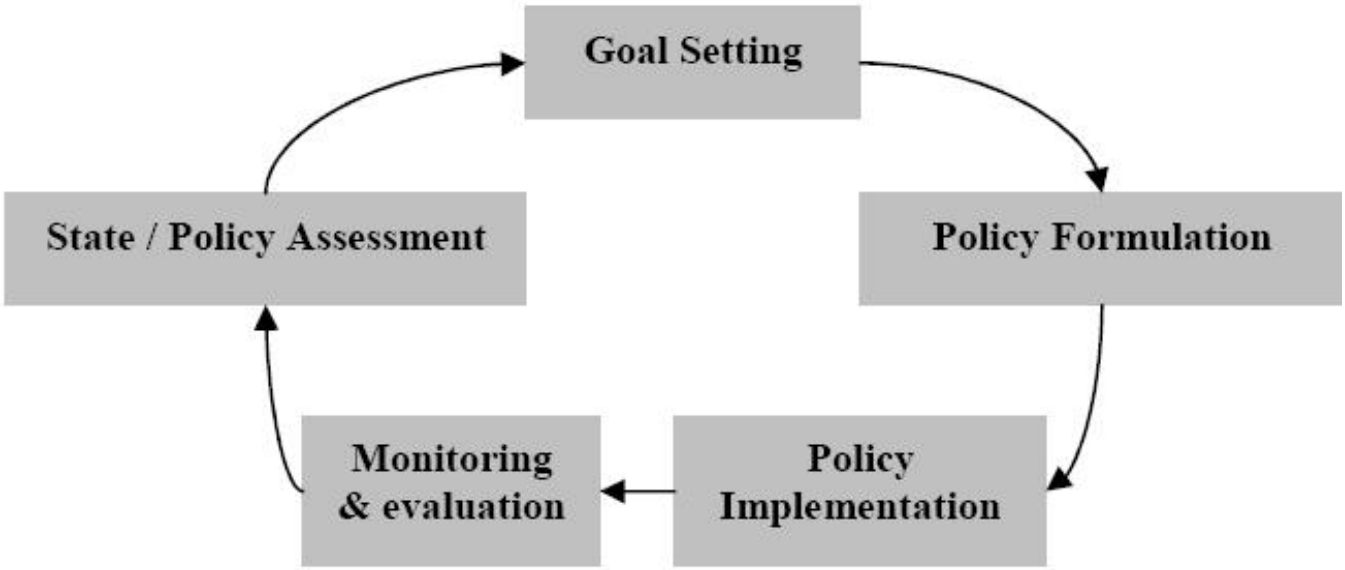
Fig. 1. The adaptive management cycle (Pahl-Wostl 2007).



can be obtained. Such an overview allows for designing "experiments" that minimize the risk of degradation of the ecosystem, in particular irreversible change, and failure of ecosystem services. Furthermore, joint policy formulation, implementation, and evaluation may improve learning and increase support for policy changes. One strategy to avoid unnecessary risks is to use simulation models to develop system knowledge and inform the debate (Lee 1999).

Despite its popularity, adaptive management is not without its problems. First, the meaning of adaptive management is not fixed. Within the literature, two interpretations of adaptive management can be distinguished: "scientific adaptive management," which focuses on experimentation as a means to learn more about the social ecosystem, and "adaptive co-management," which emphasizes the importance of stakeholder involvement (cf. McLain and Lee 1996, Olsson et al. 2004). Secondly, although the number of examples of adaptive management is increasing (e.g., McLain and Lee 1996, Gilmour et al. 1999, Tompkins and Adger 2004), these examples often remain limited to small scales and to modeling instead of experimentation (Walters 1997, Lee 1999). One explanation given for this in the adaptive management literature is that current institutional settings are often too constraining and inflexible to allow continuous improvement (e.g., Walters 1997, Gunderson 1999, Johnson 1999, Folke et al. 2005). Yet, this literature does not provide us with a comprehensive overview of institutional factors that support adaptive management (cf. McLain and Lee 1996).

This paper sets out to provide such an overview in the form of a framework for assessing the adaptive capacity of transboundary river basin management regimes. First, it identifies the features of transboundary management regimes that are mentioned in water management literature as central to effective management. Second, it complements and refines these features using adaptive management literature and elaborating on it. These features are subsequently collated into a framework for assessing the adaptive capacity of transboundary river basin management regimes. Finally, the paper applies the framework to two selected regimes—the management regimes of the Orange Basin in Southern Africa and the Rhine Basin in Western Europe—in order to test whether it can be used for describing and assessing actual regimes. The paper concludes with a discussion of the framework and recommendations for further research.

KEY FEATURES OF TRANSBOUNDARY MANAGEMENT REGIMES

There are presently some 260 transboundary river basins around the world, covering 45% of the land surface of the earth (Wolf et al. 1999). Unilateral action in these basins is often ineffective, inefficient, or simply impossible, e.g., a dam on a boundary stretch of a river. Moreover, it can harm the other basin countries (UN ESCAP 2003). For this reason, transboundary cooperation is necessary.

Transboundary cooperation is shaped by, and contributes to, the development of transboundary management regimes. According to Krasner (1983), a transboundary regime consists of "implicit or explicit principles, norms, rules, and decision making procedures around which actors' expectations converge in a given area of international relations." Consequently, river basin management regimes are defined as the principles, norms, rules, and decision-making procedures around which actors' expectations in (transboundary) river basin management converge.

In this paper, we focus on five central regime elements: actor networks, water law, water policy, information management, and financing systems (Fig 2). Key elements are the—relatively stable but not unchanging—actor networks. The actor networks make the laws and policies, which in turn influence their activities (cf. structuration theory; Giddens 1984). Management regimes can be distinguished from operational management: the technical measures and the regulatory, financial, and communicative instruments that directly intervene in the physical river basin system, or directly address the users of the river and the river basin. Moreover, management regimes can be distinguished from the general institutional and political context and from regimes in other policy fields (see Fig. 2). This section summarizes the main features of transboundary river basin management regimes that are mentioned in literature as being central to effective management.

Actor Networks

Transboundary cooperation can be institutionalized by the establishment of international river basin commissions (Dieperink 1998). Ideally, they should support an interdisciplinary and intersectoral approach (Wolf 1998). International river basin authorities with decision-making and enforcement powers can be practical for performing specific operational tasks, like restoration of water quality or operation and management of infrastructure (Mostert et al. 1999). Non-governmental organizations (NGOs) and donors can play a valuable role in transboundary river basin management as well. Although this may take more time initially, involvement of NGOs and the general public can support cooperation and enlarge the acceptance of proposed measures (Huisman et al. 2000).

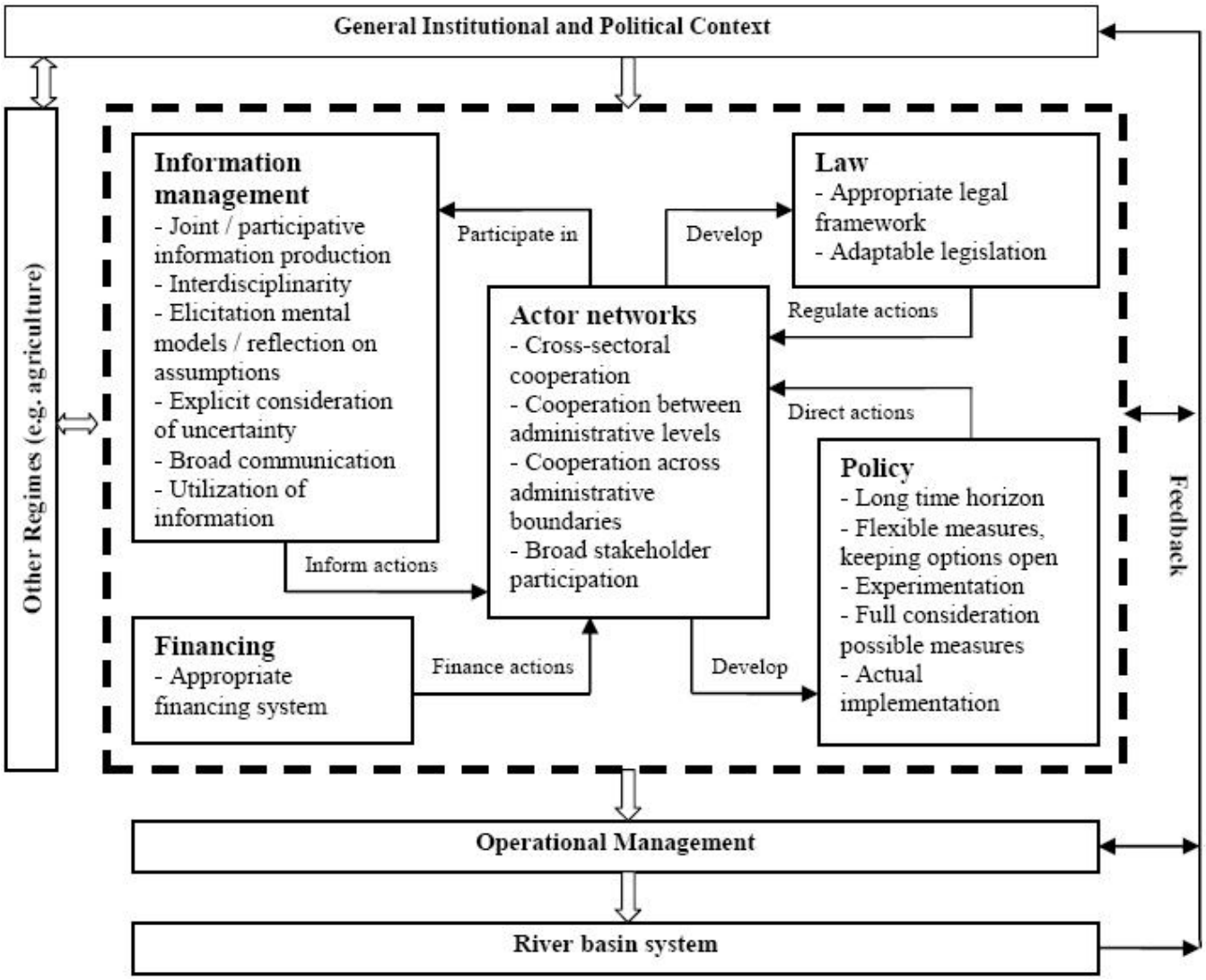
Legal Framework

Transboundary river basin management can be analyzed in terms of the development and implementation of international "agreements," such as treaties, protocols, gentlemen's agreements, tact understandings, etc., including binding laws and non-binding policies (Bernauer 2002, Mostert 2005). To conform to international law, agreements should reflect the relevant principles of equitable and reasonable utilization, the obligation not to cause significant harm, and the duty to notify and exchange information (Mostert et al. 1999). Another important aspect is how the legal framework deals with information exchange and communication across different legal and institutional frameworks, cultures, and languages (Gooch et al. 2006). Finally, the likelihood and intensity of dispute decreases as treaties, as well as water management bodies, have the capacity to absorb rapid physical or institutional change (Wolf et al. 2003).

Policy

Policy refers to the goals of government, or other organizations, and the strategies to reach these goals. Policies can be recorded in formal documents or followed in practice. To promote effective implementation, policies should be tailored toward the specific interests and resources of the involved parties (Marty 2001). In addition, policies should be updated periodically to provide an opportunity to adapt objectives and measures to changing conditions and the opinions of society (Huisman et al. 2000, Marty 2001).

Fig. 2. River basin management regime and criteria for an adaptive regime.



Information Management

Information management is the iterative process of determining information needs, and producing, exchanging, and using information. Cooperation in information management, e.g., joint monitoring, is often an effective way to start developing trust between riparian countries. Free access to information is an essential precondition for this (Mostert et al. 1999, van der Zaag and Savenije 2000). National governments and transboundary commissions should exchange information and actively disseminate information to the public (Nilsson 2003). This can result in the development of an improved technical capacity, more mutual understanding, a shared vocabulary, and shared insights (Mostert et al. 1999, van der Zaag and Savenije 2000). To broaden the knowledge base and prevent selective information use, institutional mechanisms should be put in place to ensure that all available information is used. These mechanisms include requirements for public participation, and offering possibilities for counter expertise (Timmerman 2004).

Financing

Without a good financing system, transboundary river basin management is not viable in the long run. The costs of transboundary river basin management include the costs of producing a diverse set of public goods (e.g., flood protection) and market goods (e. g., hydropower), as well as the costs of the management process itself (e.g., travel costs). In so-called developing countries, international donors and banks often bear the management costs of negotiating an international treaty, but they may also finance river basin commissions and research projects for a longer time, and give loans for specific projects. The effectiveness of donor and bank involvement can be improved greatly when they coordinate their activities better (Wolf 1998, Mostert et al. 1999, Mostert 2005). However, too much dependence on donors and banks makes management vulnerable. Financial as well as ecological sustainability can be improved by recognizing water as an economic good and recovering the costs as much as possible from the users (Global Water Partnership (GWP) 2003). Water pricing can reduce excessive water use, but at the same time, access to clean water and sanitation should be offered to all humans at an affordable price (International Conference on Water and the Environment (ICWE) 1992). The provision of public goods and the management costs can be financed from national taxes, such as general taxes or a tax per hectare. Governments should have a financing strategy to match income with costs (GWP 2003).

Cooperation Process

In addition to regime features, literature on transboundary river basin management also contains many lessons for the international cooperation process. Probably the most important requirement for successful international cooperation is mutual trust, which can only be developed in small steps (Mostert et al. 1999, Huisman et al. 2000). Political cooperation can more easily be established when technical cooperation is already in place. To convince upstream parties of the need for cooperation, downstream parties often have to be alert and creative (Dieperink 1998, van der Zaag and Savenije 2000). It is also important to identify and solve conflicts before they escalate (Wolf 1998). Water management disputes can often only be solved through active dialog among the disciplines that are relevant for the issue at stake, and by involving policy sectors other than water, as this can open up new opportunities for win–win situations, e.g., through issue linking (Mostert et al. 1999, Huisman et al. 2000, van der Zaag and Savenije 2000). Other mechanisms that can be used for overcoming conflicting interests include financial compensation, and accepting less favorable agreements in the expectation that other countries will do the same ("diffuse reciprocity") (LeMarquand 1977, Mostert et al. 1999).

ADAPTIVE RIVER BASIN MANAGEMENT REGIMES

The literature on transboundary river basin management does not provide a satisfactory overview of institutional features that support adaptive management. Many articles are based on one or a few cases only, different theoretical approaches are used, e.g., institutional economics, politics, geography, and engineering, and, most importantly, the issue of uncertainty and change is addressed to a limited extent only. However, using the adaptive management literature, it is possible to complement and refine the insights gained, and develop a complete framework for assessing the extent to which transboundary river basin management regimes support adaptive management. The framework consists of a number of criteria for the different regime elements, and indicators for each criterion (Table 1). Although some of the criteria and indicators have been derived directly from the literature, others had to be developed by the authors themselves. The framework focuses on the international level, but it can also be applied at the national and sub-national levels, where many crucial decisions for transboundary management are made.

Actor Networks

A central requirement of adaptive management is active learning by all relevant stakeholders (Pahl-Wostl and Hare 2004, Folke et al. 2005). Transboundary water management often centers around national governments, taken as unitary actors, but in addition, cooperation is needed between different government sectors and government levels, between government authorities, NGOs, and individual citizens, and between all

Table 1. Framework for adaptive management regimes (Raadgever and Mostert 2005)

CRITERIA	INDICATORS
A. Actor networks	
1. Cross-sectoral co-operation	• Sectoral governments actively involve other government sectors • Cooperation structures include government bodies from different sectors; many contacts generally • Conflicts are dealt with constructively, resulting in inclusive agreements to which the parties are committed
2. Cooperation between administrative levels	• Lower-level governments are involved in decision making by higher-level governments • Cooperation structures include government bodies from different hierarchical levels; many contacts generally • Conflicts are dealt with constructively, resulting in inclusive agreements to which the parties are committed
3. Cooperation across administrative boundaries	• Downstream governments are involved in decision making by upstream governments • International/ transboundary cooperation structures exist (e.g., river basin commissions); many contacts generally • Conflicts are dealt with constructively, resulting in inclusive agreements to which the parties are committed
4. Broad stakeholder participation	• Legal provisions concerning access to information, participation in decision making (e.g., consultation requirements) and access to courts • Cooperation structures include non-governmental stakeholders • Non-governmental stakeholders actually contribute to agenda setting, analyzing problems, developing solutions, and taking decisions (“co-production”) • Non-governmental stakeholders undertake parts of river basin management themselves, e.g., through water users’ associations • Governments take stakeholder input seriously

(con'd)

B. Legal framework	
5. Appropriate legal framework	• A complete and clear legal framework for water management exists (with sufficient detail) • Policies have to be reviewed and changed periodically
6. Adaptable legislation	• Laws and regulations can easily be changed • Water (use) rights can easily be changed / are not permanent
C. Policy	
7. Long time horizon	• Solutions for short-term problems do not cause more problems in the (far) future (20 years or more) • Preparations are already being made for the (far) future (20 years or more)
8. Flexible measures, keeping options open	• Measures taken now or proposed for the near future do not limit the range of possible measures that can be taken in the far future and are preferably reversible
9. Experimentation	• Small-scale policy experiments take place / are financially supported
10. Full consideration of possible measures	• Several alternatives and scenarios are discussed • Alternatives include small- and large-scale and structural and non-structural measures
11. Actual implementation of policies	• Plans and policies are actually implemented • Policies are not dogmatically stuck to when there are good reasons not to implement them, e.g., new and unforeseen circumstances and new insights
D. Information management	
12. Joint or participative information production	• Different government bodies are involved in setting the terms of reference and supervising the search, or are at least consulted (interviews, surveys etc.) • The same for non-governmental stakeholders
13. Interdisciplinarity	• Different disciplines are involved in defining and executing the research: in addition to technical and engineering sciences, also, e.g., ecology and the social sciences

(con'd)

14. Elicitation of mental models / critical self-reflection about assumptions	• Researchers allow their research to be challenged by stakeholders and present their own assumptions in as far as they are aware of them • Research results are not presented in an authoritative way, but in a facilitative way, to stimulate reflection by stakeholders about what is possible and what it is they want
15. Explicit consideration of uncertainty	• Uncertainties are not glossed over, but communicated (in final reports, orally)
16. Broad communication	• Governments exchange information and data with other governments • Governments actively disseminate information and data to the public: on the internet, and also by producing leaflets, through the media, etc.
17. Use of information	• New information is used in public debates (and is not distorted) • New information influences policy

As to the issues for which information should be produced, communicated, and used, see under C.

E. Financing

18. Appropriate financing system	• Sufficient (public and private) resources are available • Costs are recovered from the users by public and private financial instruments (charges, prices, insurance, etc.) • Decision making and financing under the same control • Authorities can take loans and depreciate their assets to facilitate efficient use of resources and replacement of assets

these and the experts. All these actors have different resources that are necessary for transboundary river basin management, such as information, expertise, funds, and legal competencies. To improve the legitimacy and efficacy of management, the views of all relevant stakeholders should be taken into account. This requires, first, that authorities, experts, and stakeholders realize that they depend on each other for reaching their own goals. Next, they need to start interacting, share their problem perceptions, and develop different potential solutions. This requires development of mutual trust, recognition of diversity, and critical self-reflection. Finally, the stakeholders need to make joint decisions and make arrangements for implementation (Gray 1989, Ridder et al. 2005).

Legal Framework

The adaptive management literature does not contain many specifics concerning the legal framework. Reasoning from the logic of adaptive management, however, we hypothesize that water

law should be complete and clear, enabling all stakeholders to express their concerns and provide input into management, and providing all legal tools for regulating the use of the environment, while still allowing sufficient freedom to experiment with new approaches. Developing such a framework is a difficult balancing act requiring a lot of skill and creativity. A complete legal framework should include arrangements for public participation, information management, financing, and planning, as well as many provisions concerning operational management, such as permitting (cf. GWP 2003). It should also contain provisions to regularly review and, if necessary, adapt policies. The framework itself should be adaptable as well. The legislative process should not be too time consuming and complex, and individual water rights should not be permanent, but subject to review, in order to adapt to changing circumstances and new insights.

Policy

As mentioned in the introduction, adaptive management acknowledges the uncertainty inherent in policy making, and therefore, advocates developing robust and flexible policies. This requires that the full range of possible measures is considered, and that these measures are assessed in different scenarios, such as "weak" or "strong" climate change and "weak" or "strong" economic growth (e.g., van der Heijden 1996, Carpenter and Gunderson 2001). Moreover, policies should keep as many options open as possible, and be flexible to change when new evidence comes up (e.g., Carpenter and Gunderson 2001). The reason for this is, first, it may be impossible to identify measures that perform well under all scenarios. Second, it is impossible to anticipate all eventualities: future developments may lie outside the scope of the scenarios considered. And third, even in the current situation, our knowledge of ecological and social systems is insufficient for predicting the effects of measures with complete certainty. For this reason, small-scale policy experiments could be conducted (cf. Gunderson et al. 1995). Generally, a long time horizon should be applied, and last but not least, policies should be implemented. This usually requires that the stakeholders responsible for, or influencing, the implementation of policies already participate in policy development (see the paragraph on Actor Networks, above).

Information Management

As active learning by all relevant stakeholders is central to adaptive management, information management should actively involve all important governmental and non-governmental stakeholders. Stakeholders should have the opportunity to express their information needs, direct information production, and exchange and discuss data and viewpoints to develop a shared knowledge base and mutual understanding of the system to be managed and the problems that occur (cf. Timmerman and Langaas 2005). The shared knowledge base should integrate technical, political, and process knowledge in order to facilitate informed decision making and avoid unnecessary risks. Moreover, the shared knowledge base should reflect the perceptions of all stakeholders in order to promote the legitimacy and quality of the knowledge. This requires that stakeholder perceptions, or "mental models," including those of the experts, are first elicited and then discussed. Experts should not impose their, often mono-disciplinary, view on the issues at stake, but reflect critically on their own assumptions, and be open to the expertise of other disciplines and the local population. Experts should also communicate uncertainties, and not assume that other stakeholders cannot cope with uncertainty (Wynne 1996). Transparency about information and its limitations decreases the risk of misinterpretations and strategic information use purely to legitimize policy, and maximizes the chances of real learning (cf. Weiss 1977). As implementation of policies often occurs at the local level, and the effects are often felt at this level, there is a need for effective information transfer between the transboundary and the local level.

Financing

The challenges for the financing system of transboundary river basin management are to ensure sufficient funding, prevent perverse price incentives, and maximize learning opportunities. Moreover, the total costs should remain acceptable. Although participatory approaches, experimentation, and monitoring of the outcome costs money, in the long run they may prevent costly delays and the construction of unnecessary, expensive infrastructure (cf. Beierle 1998, Carnes et al. 1998, Chess and Purcell 1999, Charnley and Engelbert 2005). Financing systems are most robust when they can rely on multiple sources. As stated before, cost

recovery, e.g., by means of water pricing, adds to the robustness of the financing system by adding private funds, and may reduce water use and pollution. In addition, cost recovery may limit the construction of infrastructure. Infrastructure is often inflexible, as it cannot easily be adapted to changes, e.g., in water demand. Ideally, decision making, financing, and benefiting should be in one hand. This promotes the integral assessment of measures and the implementation of measures that have been agreed upon, and minimizes the chance of overuse because others have to pay the bill—literally or metaphorically (cf. Huitema et al. 2008). That being said, a perfect match usually is not possible, and river basin management should not become too complex. Finally, authorities should be able to take loans and depreciate their assets. This makes it easier to make long-term investments that would otherwise have to be financed in one year, and ensures that assets can be replaced in time.

ASSESSMENT OF THE ORANGE AND RHINE REGIMES

The framework described in the previous section has been applied to seven transboundary river basin management regimes in Europe, Africa, and Asia in order to test whether it can be used for describing actual regimes and assessing their adaptive capacity (Raadgever and Mostert 2005; see Fig. 3). For each basin, one or more researchers with experience in that basin first performed a literature study to describe the regime according to a common format (see the individual case study reports: Becker 2005, Kranz et al. 2005a, 2005b, Raadgever 2005a, 2005b, Timmerman 2005, Timmerman and Doze 2005). In the Rhine and Orange basins, additional interviews were conducted to capture less formalized knowledge. Secondly, the researchers scored "their" regimes for each criterion for adaptive regimes (cf. Table 1), using a three-point scale: 1) low, 2) average, or 3) high. Then, the scores for the different basins were compared and discussed to check whether all researchers had applied the criteria in the same way. This resulted in some small adjustments to the scores.

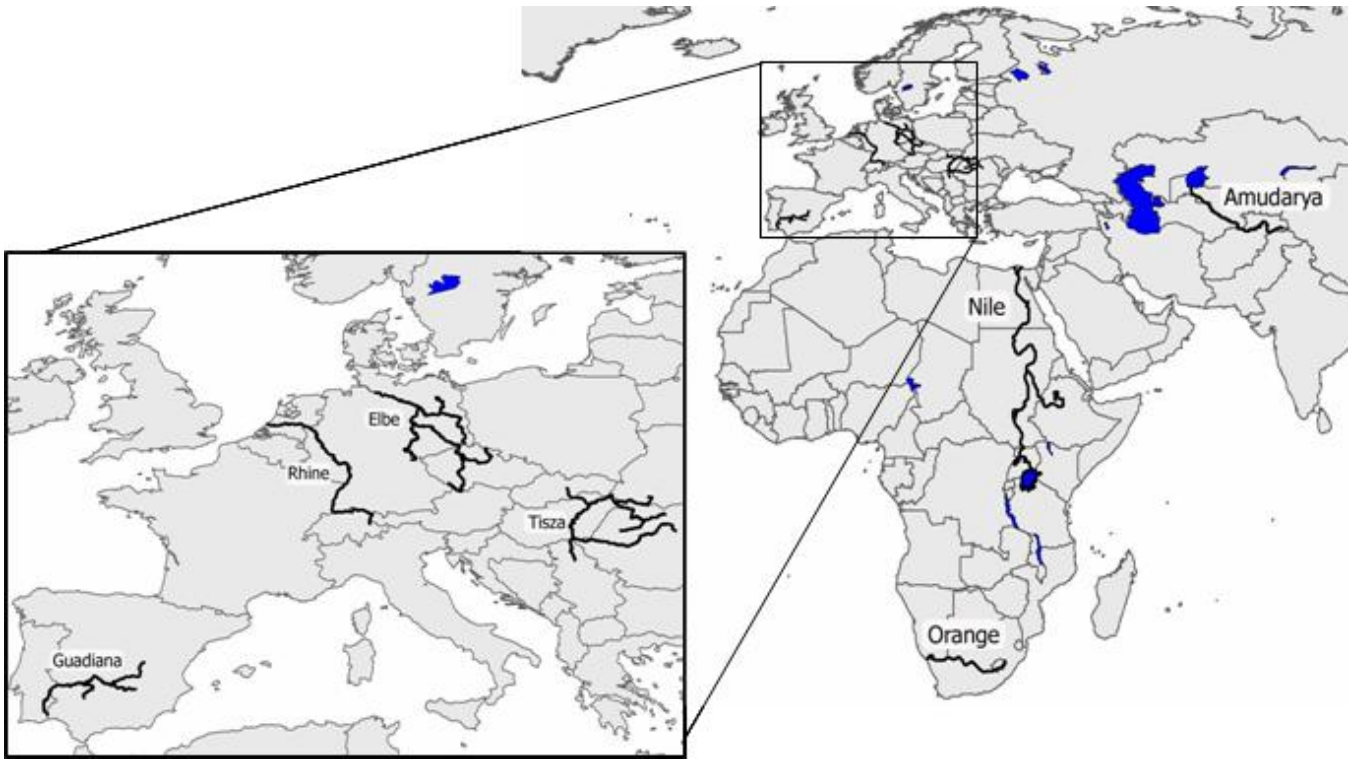
In this section, we present the results for two of the seven basins: the Orange and Rhine (Table 2, Figs. 4 and 5). These basins have been selected because of the high availability of information. Even so, information on some of the criteria was limited, especially on criteria 14 and 15. The assessment of the two regimes revealed large differences between the two basins. The Rhine regime scores higher on the criteria for an adaptive regime than the Orange regime. A summary of the results can be found in Table 3 and more details can be found in the basin reports (Kranz et al. 2005a, Raadgever 2005b).

Assessment of the Regime in the Orange Basin

The Orange basin regime scores average on the criteria, with a lot of progress in recent years (Kranz et al. 2005a). Transboundary cooperation is still in an emerging state, as the Orange-Senqu River Basin Commission (ORASECOM) was only established in 2000. The development of transboundary institutions has been driven by donors, who have been involved in financing the establishment of the ORASECOM, financing participatory processes, and financing concrete research projects in the basin. Donor funding may not be the ideal financial source for adaptive management (see below), but it did contribute to the development of cooperation and more complete law. Integration of the water sector with other sectors is still low. Although government structures are traditionally top down, there is increasing awareness that local levels should be more intensively involved in international planning processes. Improving public participation has been identified as a major task of the ORASECOM, and serious efforts have been undertaken to fulfill this task, e.g., the development of a roadmap for public participation. In addition, provisions for stakeholder participation have been established in new water laws and policies—most prominently in South Africa— but implementation is still limited. This may be explained by the lack of adequate methods for communication with relevant stakeholder groups, particularly in rural areas.

International law in the basin consists primarily of the Southern African Development Countries Protocol on Shared Watercourses, the legal framework around the ORASECOM, and several bilateral agreements. These do not yet constitute a comprehensive legal framework, but they are adaptive to some extent. The legal framework clearly refers to integrated water resources management (IWRM) as the guiding principle for water management. National water laws are explicitly linked to international agreements. They have undergone several adjustments and updates

Fig. 3. Map of the seven studied river basins.



over recent years, and some have included provisions for a periodical update.

Policy development in the Orange basin scores average, but policy implementation scores low. Water management in the basin has traditionally concentrated on large-scale infrastructure, such as dams and water transfer pipelines, tailored toward meeting short-term water demands of individual countries. Recently, there is a lot of discussion on the long-term adverse effects of large-scale infrastructure, and alternatives such as demand management, stricter regulation, and benefit sharing among riparian states have been advocated. Implementation of transboundary policies is very slow, but many stakeholders expect a lot from the multilateral planning under the auspices of the ORASECOM within the coming years.

The Orange basin scores average with respect to shared production of information between the riparian countries, but low with respect to information exchange and utilization. Several research institutes and universities are involved in data collection on various issues of water management. The need to develop, exchange, and integrate data has been clearly identified, as a key task of the ORASECOM. However, an integrated data and information system has not been established yet. The dissemination of information by the ORASECOM to stakeholder groups is limited.

The Orange basin scores low with respect to the financing system. Financial contributions of international donors have been quite instrumental in the development of large infrastructural works, which increased the availability of resources, but also increased dependence on third parties. Currently, donor efforts seem to be concentrating more and more on institutional capacity building, which is expected to support adaptive management by contributing to cooperation, law, and policy. In addition, the member states have been more and

Table 2. Overview of main characteristics of the Orange and Rhine river basins

Basin	Basin Area (10^3 k-m^2)	River Length (km)	Average discharge at mouth (m^3/s)	Countries	Main river/ water users	Main issues
Orange	948 †	2200	95 ‡	South Africa Namibia Botswana Lesotho	• Irrigation / agriculture • Environmental demands • Power generation • Industry • Domestic use	• Water availability / allocation • (Interbasin) water transfers • Droughts
Rhine	198 §	100	2200	Germany Netherlands Switzerland France Austria Luxembourg Belgium Liechtenstein Italy	• Navigation • Irrigation / agriculture • Industry • Power generation • Domestic use • Waste water disposal • Recreation	• Pollution / water quality • Floods • Ecological restoration

† Based on Wolf et al. (1999)
‡ Interpretation of graph of discharge at downstream location (South Africa Department of Environmental Affairs and Tourism. 1999. National State of the Environment Report). [online] URL: http://www.ngo.grida.no/soesa/nsoer/issues/water/state2.htm#rivers)
§ Based on Coördineringscomité Rijn. 2005. Internationaal stroomgebiedsdistrict Rijn - Kenmerken, beoordeling van de milieueffecten van menselijke activiteiten en economische analyse van het watergebruik (Deel A = overkoepelend deel, stand 18-03-05). [online] URL: http://www.kaderrichtlijnwater.nl/

more involved in the financing of the ORASECOM, and have recently split the costs of the permanent secretariat among the four of them.

Assessment of the Regime in the Rhine Basin

In the Rhine basin, long-lasting institutional stability has created opportunities to develop trust and cooperation, and thus this region is closest to meeting the criteria (Raadgever 2005b). In the International Commission for the Protection of the Rhine (ICPR), the riparian countries have cooperated for many decades. The ICPR consists of a plenary commission, comprising national representatives, permanent multidisciplinary working groups, and a secretariat, supporting the plenary commission and the working groups. Adjustment of water policies with agricultural and spatial planning policies takes place, to some extent, at the national and sub-national levels. Lower-level governments are often involved in the implementation of (inter)national policy. Non-governmental organizations, citizens, and the scientific community are involved in many different ways in water management, and a high degree of organization and cooperation between various actors has been established. Formal procedures for participation in decision making and access to information are well-established in all basin states.

The legal agreements developed in the framework of the ICPR focus on institutional issues, and chloride and chemical pollution (cf. Dieperink 1998). Several, non-legally binding, policy documents, such as the Rhine Action Plan of 1987, contain additional provisions concerning water quality, ecology, and flooding. An influential legal

Fig. 4. Map of the Orange basin (South African Department of Water Affairs and Forestry, retrieved 22 August 2007 from http://www.dwaf.gov.za/orange/images/rm017m6.gif).

Fig. 5. Map of the Rhine basin (UNEP/DEWA/GRID-Europe, Retrieved 22 August 2007 from http://www.grid.unep.ch/product/publication/freshwater_europe/images/map4.jpg).

Table 3. Qualitative scores of basins on criteria for adaptive management (- = low, 0 = average, + = high)

	Criterion	Orange	Rhine
A.	Actor networks *(Average 1–4)*	0	0 / +
1.	Cross-sectoral cooperation	-	0
2.	Cooperation between administrative levels	0	0
3.	Cooperation across administrative boundaries	0	+
4.	Broad stakeholder participation	0	+
B.	Legal framework *(Average 5–6)*	- / 0	0 / +
5.	Appropriate legal framework	-	+
6.	Adaptable legislation	0	0
C.	Policy (*Average 7–11)*	0	+
7.	Long time horizon	0	+
8.	Flexible measures, keeping options open	0	+
9.	Experimentation	0	0
10.	Full consideration of possible measures	0	+
11.	Actual implementation of policies	-	+
D.	Information management *(Average 12–17)*	- / 0	0 / +
12.	Joint / participative information production	0	+
13.	Interdisciplinarity		0
14.	Elicitation of mental models / critical self-reflection about assumptions		
15.	Explicit consideration of uncertainty	0	0
16.	Broad communication		+
17.	Use of information	-	0
E.	Financing *(18)*	-	+
18.	Appropriate financing system	-	+

document is the EU Water Framework Directive (2000/60/EC), which includes many requirements for river water quality, ecology, and the water management process. The international law and policy are elaborated in comprehensive systems of national and lower-level law. In most Rhine countries, adaptation of water law, regulations, and policy are possible, and in some cases, periodic review is obligatory.

The ICPR policies contain a wide range of small- and large-scale, structural and non-structural measures, and usually have a long time horizon. The planning horizon of the ICPR flood policy (Internationale Kommission zum Schutz des Rheins (IKSR) 1998), for instance, is the year 2020. The national governments usually adjust their national policies to ICPR policies, and implement the agreed measures. Nevertheless, implementation may take a long time. For example, the ambitious goals of the Rhine Action Plan on Floods were not fully realized as planned (IKSR 2001). The implementation of ICPR plans is evaluated on a regular basis, but there are no legal sanctions in case of non-compliance.

The ICPR member states exchange data, cooperate in research, and exchange interests and points of view. National governmental actors participate in the production of information and in the ICPR working groups, and NGOs participate in the working groups as observers. Uncertainties are usually assessed. Legal obligations to make information accessible have been established at several levels, and the ICPR disseminates a lot of information via its website. The ICPR policies reflect the information that is produced by its working groups, but it can take a long time before information on emerging issues enters national and transboundary policy debates.

The work of the ICPR, as well as the implementation of its policies, is financed out of public resources of the riparian countries. As they also make all the important decisions in the ICPR, decision making and financing are in one hand, and there is no reliance on third parties. At the national level, collective water management issues, such as flood management, are financed mainly from public resources, whereas the costs of water supply and wastewater treatment are to a large extent recovered from the users.

DISCUSSION AND CONCLUSIONS

We set out to develop and test a framework for assessing the adaptive capacity of transboundary river basin management regimes. This framework hypothesizes what the actor networks, laws, policies, and information management and financing systems in a transboundary river basin should look like in order to support adaptive water management. As mentioned in the introduction, adaptive management could be useful for dealing with complex problems, uncertainty, and change. However, adaptive management may not be necessary in every situation (van Eeten and Roe 2002). Adaptive management involves high costs, including the high transaction costs of the necessary cooperation and integration (Dombrowsky 2007), and the costs and time needed for gathering the necessary technical information (Lee 1999). These high costs may not be justified when dealing with well-structured issues (cf. Johnson 1999), which are characterized by agreement about the goals to be achieved and sufficient technical knowledge. However, many water management issues are not well structured, especially in a transboundary context, and for these issues, adaptive management provides a useful conceptual model for dealing with complexity.

Our framework reflects one specific interpretation of adaptive management that values stakeholder participation and scientific experimentation equally, and combines them in one approach. In our view, the participatory and scientific aspects of adaptive management cannot be strictly separated, because even scientific knowledge is not value free, but influenced by the people involved in producing it (cf. Douglas 2005). The hypotheses in the framework have not yet been tested in any strict sense. We have assessed the "independent variables," regime characteristics, but not the "dependent variables," operational water management. This would require the development of criteria and indicators for adaptive operational management. However, adaptive management as incorporated in the framework, as well as many other interpretations of the concept, leaves room for very different types of operational management. It does not provide complete answers to normative questions about who should adapt, for whom or for what, or how much it may cost. Adaptive management may result in solutions that benefit all interests involved, e.g., nature protection and economy, but often difficult choices remain. In theory, the concept offers little

help in making these choices. In practice, however, people using or advocating adaptive management have their own preferences and may make their own, implicit and even subconscious choices. Our own ideal is for adaptive management to promote an open discussion of both the results and the means of river basin management, and to help stakeholders to make their own choices.

Although the framework has not been fully tested, it has been applied to the Rhine and Orange basins in order to test its potential for describing and assessing actual management regimes. This has resulted in a comprehensive description of the two regimes. Moreover, their (hypothetical) support for adaptive management has been assessed, and regime elements that require further development have been identified. The assessment of the regimes has been performed by researchers familiar with the respective areas, and has been checked by other researchers, but it remains to some extent subjective. To reduce this subjectivity, more objectively measurable indicators, e.g., scaled and/or quantitative indicators, for the different criteria should be developed.

The assessment results indicate that the criteria for adaptive regimes have only been partially met in the case study basins. An interesting topic for further research is whether adaptive regimes are feasible. The situation in the Rhine suggests that many elements of an adaptive river basin regime can be developed. The situation in the Orange basin suggests that not all elements of an adaptive management regime can develop when the general institutional and political context is not ready for it. However, the institutional and political context is not static, nor are the management regimes themselves. Regime development in general is a never-ending, long-term process. The development of international agreements usually takes 10 or more years, and sometimes even 100 years (Mostert 2005). Regime developments could be analyzed using collaboration theory (Gray 1989), focusing on the role of individuals (e.g., Majone 1989, Saleth and Dinar 2004) or on group processes (e.g. ,Ostrom 1990). Better insight into the order and time scale of regime development is needed to support the transition toward adaptive management regimes and to identify leverage points. For this purpose, detailed case studies of regime development over time, and more theoretical work on regime development, should be undertaken, each informing the other (Conca et al. 2006). The influence of contextual factors that could block or enable the functioning and formation of adaptive regimes, such as the distribution of power, costs, and benefits over the upstream and downstream countries, also needs additional attention.

Responses to this article can be read online at:
http://www.ecologyandsociety.org/vol13/iss1/art14/responses/

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